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BARLEY

CULTURE
USES AND
VARIETIES

BARLEY should be more widely grown in the Northern and Western States. It is an excellent grain feed for stock, being almost the equal of corn. It, however, competes with corn in few places, as it is mostly grown outside the limits of profitable corn culture. It produces more pounds to the acre than oats or wheat. If necessary, it can be seeded later than spring wheat and hence interferes little with the wheat acreage in the spring-wheat region. It supplies the needed grain feed necessary for the increase of livestock, which sometime must come with diversified farming in the areas where grain farming is now the only enterprise.

The best lands for barley are well-drained soils that are not sandy. The best returns are obtained from early seeding. The best methods of preparation are fall plowing in the humid-spring region, disked corn ground on the Great Plains, and summer fallow in sections where the crop is winter seeded. The best method of seeding is with a drill, and the best method of harvesting is with a binder. The grain should not be threshed too close, as broken kernels lower the market value.

The best-yielding varieties are Tennessee Winter in the humid-winter region, Manchuria and Oderbrucker in the humid-spring region, and Coast, Hannchen, Club Mariout, White Smyrna, Chevalier, and Trebi in the semiarid region.

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BARLEY: CULTURE, USES, AND VARIETIES

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INCREASING THE ACREAGE OF BARLEY

THE AREA on which barley may be profitably produced in the United States is more limited than that on which corn, wheat, or oats may be grown with profit. Barley is, however, exceptionally well suited to certain sections, and in these sections is a very profitable crop. Its worth is not realized in some localities well suited to its culture. In the West its crop value is appreciated, but throughout the Northern States east of the Rocky Mountains the acreage under cultivation is far too small. In these States it is sound economics to increase the barley acreage for the purpose of producing feed for livestock. Before the law prohibiting the manufacture of beer containing more than a very small percentage of alcohol was enacted the best grades of barley went to the malt houses and only inferior grain remained on the farm to be fed. This prevented the farmers of the Mississippi Valley from realizing its full value as a feed. Even now the quantity of feed produced per acre is not appreciated by the average farmer. The acreage for stock feed could be greatly extended without prejudice to, and indeed to the advantage of, the remaining maltsters, as there would be a larger offering from which they might choose.

This publication is intended to give a brief statement of the barley areas and the culture and uses of the crop in such a way as to enable the farmer to decide whether or not it is to his individual advantage to grow barley on his farm.

BARLEY REGIONS

As shown on the accompanying map (fig. 1), the United States may be divided into three general climatic regions, which divisions differ in their economic, varietal, and cultural aspects as well as their climatic features. These will be designated as the semiarid, the humid-spring, and the humid-winter regions. In the semiarid region the period from flowering to ripening is one of scanty rainfall and a very dry atmosphere. In the humid-spring region the same period is marked by frequent summer rains and a humid atmosphere. The humid-winter region is similar to the humid-spring, except that the barley is fall sown. In the semiarid region, the California crop is winter sown, whereas in the States to the north and east of California it is spring sown.

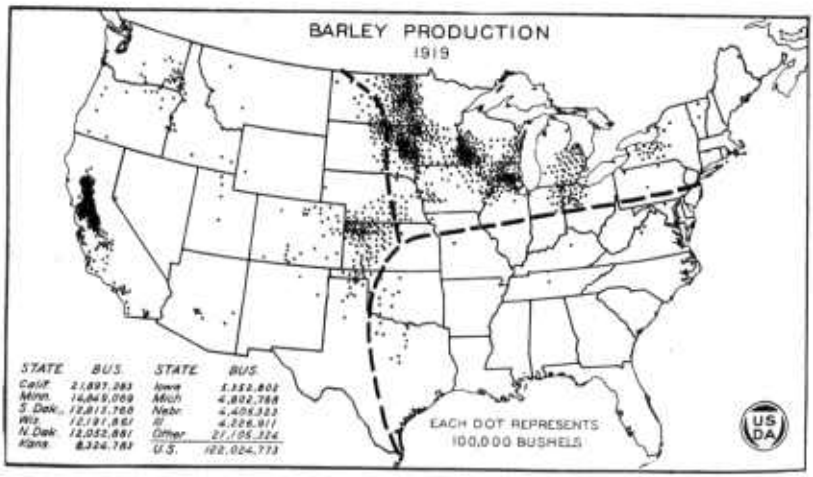

FIG. 1.—Outline map of the United States, showing the three general regions of barley production. The heavy broken lines divide the country into the humid-spring region (northeast), the humid-winter region (southeast), and the semiarid region (west). The dots show the production of barley, according to the census of 1920

It will be noted that the arid-humid line does not follow the line of rainfall in the North. This probably indicates a humidity-temperature factor. The southern Plains are much hotter than the northern, which would have a tendency to extend the humid belt in the North and contract it in the South. The line south of Nebraska is not a stable one. The culture of winter barley is increasing gradually in western Oklahoma and adjacent portions of the Texas Panhandle. At the same time the spring-barley acreage of Kansas is increasing. There is now an overlapping of the spring and winter culture in southwestern Kansas and western Oklahoma. The line separating the humid-spring from the humid-winter region is still arbitrary. Except on the Great Plains there is a wide belt between the northern limits of profitable winter-barley culture and the southern limits of profitable spring-barley culture in which barley is grown only in especially favored localities.

SPECIAL AREAS DUE TO CLIMATIC VARIATIONS

The three general regions are subdivided by variations in climate into areas of special characteristics.

In the two humid regions there are few local variations. In the South winter barley finds very favorable climatic conditions in the mountain areas, especially in eastern Tennessee. The total production, however, is insignificant. In the North some winter barley is produced in the neighborhood of the Great Lakes and in southern Ohio. In New York 2-rowed barleys can be grown with more comparative success than in the upper Mississippi Valley.

In the semiarid region there are many variations, as might be expected from the topography. The Great Plains constitute a subdivision almost equal in rank with the three regions themselves. This area, while of light rainfall, differs from the rest of the semiarid region in having a summer rainfall which modifies both the conditions of growth and the varieties grown. The entire northern Plains constitute a section especially suited to the culture of 2-rowed barleys. Hooded sorts are often grown on the southern Plains and in localities of high altitude in the Rocky Mountain region. Several counties in northwestern Kansas have a climate unusually favorable to barley production, and because it is relatively profitable the acreage is being expanded beyond these counties throughout the western part of the State, as shown in Figure 1.

The Great Basin has features peculiar to itself and distinct from California.

SPECIAL AREAS DUE TO SOIL VARIATIONS

A study of the map (fig. 1) shows that, even in the sections of greatest production where every climatic feature is favorable, there are localities where very little barley is grown and others where it is almost a predominating crop. This distribution is due to differences in soil.

Barley is very sensitive to soil variation. It demands a well-drained soil, but does not thrive on sands. The projection of barley production into less favorable climates is noticeable in the barley soils which lie along the Mississippi and Missouri Rivers. The effect of inadequate drainage is apparent in south-central Minnesota, an area favoring barley in climate, where, as shown in Figure 1, a poorly drained area separates the heavy-producing sections on either side. Oats give a higher average return than barley in this section. As a rule, soil variations affect the acreage of barley grown, but have little relation to the varieties sown or the methods of production.

ECONOMICS OF BARLEY GROWING

Barley is grown both as a cash crop and as feed. The percentage of the crop reaching the terminal markets is steadily decreasing. West of the hundredth meridian it is steadily increasing in importance as a feed grain. Wherever grown as a feed crop barley must compete with oats, in some cases with corn, and in very limited areas with wheat. For the most part, barley is grown north and

west of the limits of profitable corn culture. Where corn can be profitably grown it gives higher feed returns than either oats or barley. On most farms, however, farm-management demands (either labor distribution or rotation requirements) necessitate at least one spring-sown small grain. Wheat, because of its use as a bread crop, has a market and a resulting cash return which is not determined by feed values. The only crop that can be compared readily with barley in farm economy is oats. Both are spring sown and both are feed crops, for the excess of barley over the malting demands must depend on animal consumption for its market.

TABLE 1.—*The average acreage and yields of barley and oats, with the calculation of protein, carbohydrates, and fat, in 33 States for the years 1922, 1923, and 1924*

States	Acreage		Yields per acre (pounds)							
			Grain		Digestible nutrients					
					Protein		Carbohydrates and fat (×2.25)		Total	
	Barley	Oats	Barley	Oats	Barley	Oats	Barley	Oats	Barley	Oats
Maine	4,000	122,000	1,344	1,194	121	116	946	725	1,067	841
Vermont	9,000	78,000	1,440	1,142	130	111	1,014	693	1,143	804
New York	193,000	1,007,000	1,325	1,046	119	101	933	635	1,052	736
Pennsylvania	12,000	1,123,000	1,190	1,056	107	102	838	641	945	743
Maryland	4,000	59,000	1,598	1,002	144	97	1,125	608	1,269	705
Virginia	10,000	172,000	1,306	698	118	68	919	424	1,037	491
Ohio	74,000	1,522,000	1,224	1,094	110	106	862	664	972	770
Indiana	31,000	1,696,000	1,042	928	94	90	734	563	827	653
Illinois	223,000	3,937,000	1,430	1,104	129	107	1,007	670	1,135	777
Michigan	148,000	1,542,000	1,291	1,152	116	112	909	699	1,025	811
Wisconsin	144,000	2,531,000	1,483	1,254	133	122	1,044	761	1,178	883
Minnesota	928,000	4,240,000	1,334	1,232	120	120	939	748	1,059	867
Iowa	156,000	5,807,000	1,416	1,242	127	120	997	754	1,124	874
Missouri	5,000	1,366,000	1,200	730	108	71	845	443	953	514
North Dakota	1,203,000	2,307,000	1,104	960	99	93	777	583	877	676
South Dakota	857,000	2,451,000	1,176	1,088	106	106	828	660	934	766
Nebraska	277,000	2,440,000	1,138	931	102	90	801	565	904	655
Kansas	899,000	1,454,000	898	752	81	73	632	456	713	529
Kentucky	6,000	230,000	1,262	666	114	65	888	404	1,002	469
Tennessee	16,000	220,000	1,046	650	94	63	736	395	831	458
Texas	105,000	1,421,000	1,138	950	102	92	801	577	904	669
Oklahoma	148,000	1,380,000	1,022	714	92	69	719	433	811	503
Montana	107,000	649,000	1,210	1,008	109	98	852	612	961	710
Wyoming	26,000	164,000	1,406	1,024	127	99	990	622	1,116	721
Colorado	275,000	224,000	1,152	874	104	85	811	531	915	615
New Mexico	11,000	58,000	864	637	78	62	608	387	686	448
Arizona	32,000	20,000	1,646	1,024	148	99	1,159	622	1,307	721
Utah	21,000	81,000	1,834	1,245	165	121	1,291	756	1,456	876
Nevada	5,000	3,000	1,339	1,136	121	110	943	690	1,063	800
Idaho	93,000	172,000	1,694	1,280	152	124	1,193	777	1,345	901
Washington	90,000	210,000	1,498	1,446	135	140	1,055	878	1,189	1,018
Oregon	88,000	269,000	1,392	1,014	125	98	980	615	1,105	714
California	909,000	127,000	1,291	970	116	94	909	589	1,025	683

In all the principal barley-growing States and parts of States barley is more profitable and produces more pounds to the acre than oats. Table 1 indicates that as a matter of farm economy the barley acreage in the northern tier of States should be expanded at the expense of oats. That it is not more widely grown now is due to two causes: (1) Its rough awns make it an unpleasant crop to handle, and its value as a stock feed has not been realized by the farmers east of Montana; and (2) the brewing trade until recently

so dominated the eastern markets that buyers of feedstuffs did not think of barley as a feed crop. Barley must be considered as a feed in order to appreciate its true farm value. Not alone pounds, but pounds of digestible nutrients, should be considered.

TABLE 2.—*Digestible nutrients in each of the common cereals, as determined for animal feeds, according to Henry and Morrison*

Cereals determined	Digestible nutrients (per cent)				
	Crude protein	Carbohydrates	Fat	Carbohydrates and fat (×2.25)	Total
Barley	9.0	66.8	1.6	70.4	79.4
Oats	9.7	52.1	3.8	60.7	70.4
Corn	7.5	67.8	4.6	78.2	85.7
Wheat	9.2	67.5	1.5	70.9	80.1

In Table 2 the protein, fat, and carbohydrate contents of the four leading cereals are estimated from the analyses compiled by Henry and Morrison. In order to separate clearly the protein from the fat, the carbohydrates and fat (× 2.25) have been united into a non-

FIG. 2.—Outline map of the United States shaded to show the area in which the climate is relatively favorable for the production of barley. Within the shaded area well-drained soils that are not sandy in character produce more pounds to the acre of barley than of either oats or wheat, while corn is a competing crop only along the southern margin. The actual line of separation is irregular. Barley culture extends south of the line on favorable soils, as in northwestern Ohio, while oats are more profitable north of the line on soils unfavorable to barley production, as in north-central Iowa and southwestern Minnesota. In the mountain and Piedmont regions of the South there are local areas well adapted to winter barley

proteid factor, which has been used in Tables 1 and 2. The total is the sum of the proteid and nonproteid constituents.

The area in which barley often can be profitably substituted for oats is shown graphically on the map (fig. 2). This does not mean that there are no localities in this area in which it is not more profitable to grow oats or that there are no localities outside this area in

which it is profitable to grow barley. It does mean that within the area the general climatic and soil conditions are more favorable to large yields of barley than of oats. In Table 1 the average yield of barley, as may be seen, is higher than of oats not only in the Northern and Western States, but the same is true for many other States as well. In many of these, however, the total production is so small as to be unfair to the oat acreage. Where the barley of a State is largely localized in a definite section of the State, small acreages have more meaning. A long-established local area is usually based on sound economy, but even here modifications are constantly arising. In the winter-barley section of Tennessee and Kentucky, for example, winter-barley production has been much more profitable than that of oats. The Hessian fly may alter this relation, as barley must be sown before the fly-free date.

Although it has been estimated[1] that 161 acres of oats are equal to 167 acres of barley in California, this is true only because of the local demand for the oat hay or grain. As a matter of fact barley and oats hardly enter into competition in this State, profitable oat production being decidedly limited as to area and confined mostly to the edges of the barley-growing districts. In California, as a whole, barley is much more profitable than oats. Wheat is the real competitor of barley in California, as it is more commonly grown on lands well suited to barley culture. Hunt estimates that 235 acres of wheat are equal to 167 acres of barley in income-producing capacity. The progressive decrease in the annual wheat acreage and the progressive increase in the barley acreage sustain these estimates.

The profits of barley are modified by the cultural reason for growing the crop. Often it is not a primary crop but a secondary one, grown because of its special fitness for some abnormal condition. In certain districts, as in northwestern Kansas, it is largely second choice to wheat. If the wheat seeding is successful, wheat is grown. If for some reason the ground can not be prepared for wheat, or if the wheat does not germinate through lack of rainfall, or if it is winterkilled, spring barley is sown as a catch crop. On account of its rapid growth and early maturity, barley can be seeded later than other grains. This character is utilized in the spring-wheat area. On lands where spring wheat can not be seeded in time, barley is grown and is sure to give some sort of return.

Barley often is grown on new breaking, as its rank growth tends to subdue the wild grasses. It is commonly used to clean weedy fields, as a good growth of barley smothers many species completely. Its early maturity permits the crop to be cut before many other species have matured seed. Summer fallowing after the harvest destroys many more, and a single season of such treatment results in a marked decrease of the weed population.

Barley also is widely grown on old lands. After land has become too poor to produce good crops of wheat, it is seeded to barley. This sequence has been especially conspicuous in California. In Minnesota and Wisconsin the best barley is produced on old farm lands, which there happen to be of a fertile character. Older lands,

[1] T. F. Hunt and others. Some things the prospective settler should know. *In* Calif. Agr. Exp. Sta. Circ. 121, pp. 1–39, illus. 1914.

where suitable in character and not too depleted, produce a better quality of barley than new lands.

From the standpoint of profit, these various cultural uses of barley must be considered. The returns from a catch crop or a weedy field can not be compared with those of a primary crop, yet a very considerable percentage of the barley acreage is grown on this basis. The figures in Table 1 would doubtless be more favorable to barley production if there were some way to compensate for these legitimate but hardly comparable acreages.

In general the results of the experiments conducted by the Office of Cereal Investigations are in agreement with the census figures shown in Table 1. When comparisons are made of the best variety of barley with the best variety of oats at stations in the northern Plains area and States to the west, the returns from barley in most instances are decidedly greater than from oats.

FARMS AND SOILS WHERE BARLEY SHOULD BE GROWN

Obviously, barley should be grown on those farms where it is more profitable as a cash or feed crop than the other small grains, if the growing of a small grain fits into the scheme of field management. As has already been pointed out, this means large areas in the Northern and Western States and small areas elsewhere. Its profitableness or unprofitableness depends entirely on how nearly its optimum requirements of growth are met. Barley is a cool-weather plant. The months of growth in the heavy-producing regions will be found to satisfy this requirement, and the greater part of the crop should be grown in these established areas. Within these areas favorable soils should be chosen.

Barley should not be grown on poorly drained land. Porous soils are preferred. With drainage or light rainfall, heavy soils produce good crops. Sandy soils, even though well drained, are not good barley soils. Clay loams are perhaps the best for barley. Barley produces well on rich, new lands, and it can be grown more profitably than wheat on older lands, provided they are not too light and are well drained. Farms outside the average limit of profitable production, but still in a favorable climate, which possess desirable soil characters may be cropped to barley with profit.

PLACE OF BARLEY IN THE ROTATION

Over much of the barley-producing area no consideration is given to rotation of crops. Barley is still grown extensively rather than intensively in most of the Western States. Such rotation as is practiced is with the other small grains and ignores the greater objects of a rotation. Even in this area smaller farms are becoming common, and with the increase of livestock will come a diversification which will permit a cropping system now possible only in individual cases. East of the Red River Valley, barley is grown more as a crop of small farms which can enter into a cropping scheme. Wheat is the preferred cash crop over most of the barley region. Any rotation must consider wheat, but as this merely adds one year to the cycle the scheme is not materially altered. In sections where barley may

lodge, a crop of wheat following a manured corn crop is of advantage to the barley.

In general, barley does best after a cultivated crop. This in the United States means corn. In Canada excellent returns have been obtained after root crops. In the United States the root-crop acreage is limited to potatoes and sugar beets. The total acreage of these available for seeding to barley is too small to be considered. In the humid districts, where diversified farming is practiced, the most feasible rotation is one including corn and a leguminous hay or pasture crop.

Corn followed by barley (seeded with grass), which in turn is followed by hay or pasture, is the essential combination of a rotation for this area. This, of course, is to be modified to suit local conditions and the nature of the farm. If intended for use as hay, the grass-seed mixture might be timothy and clover; if for pasture, the mixture might include a legume and nonleguminous grasses suited to the locality. If used for hay, the grass mixture would probably stand two years; if for pasture, it might remain a longer time. If grain feed is needed, two years of corn or two of barley might be used. In the case of two years of barley, the second year the barley might be sown at a lesser rate, so as to make a better nurse crop.

Where alfalfa is used it is seldom profitable to break up the alfalfa land in less than three years, and it is usually profitable to leave it still longer.

In the arid regions corn is a far less common crop. The acreage is increasing, however, and the use of silos is certain to extend it still farther. Investigations have shown [2] that on the Great Plains the largest returns per acre were obtained after summer fallow, but on account of the cost of summer tillage the crops on disked corn ground were much more profitable. Potatoes, where grown, occupy the same place as corn in the scheme of rotation. In eastern Oregon and Washington and to a lesser extent in Idaho, Wyoming, and Montana, field peas may take the place of both the corn and the hay crop, the rotation probably being peas, wheat, and barley. Much of the barley west of the ninety-eighth meridian is certain to be grown without definite rotation until economic conditions have altered considerably. In the South winter barley occupies the same place as wheat. The best returns are obtained after plowing under a leguminous crop, as after cowpeas plowed under the first of September. In the Piedmont region corn in which crimson clover is seeded, crimson clover followed by cowpeas, and barley make a 3-year rotation which can be extended by the use of a second barley crop and, if in a stock-raising region, by the addition of pasture. In the Coastal Plains barley does not succeed well on sandy soils, and stock farming is not common. Where the soils are suitable, corn, cowpeas, and barley may form the basis of the rotation. In some places velvetbeans are much better than cowpeas. The advisability of growing barley there usually would depend upon the relative cash returns of wheat and barley. In the South there is a possible exception. Where hogs are raised and fattened on peanuts, barley may be of unusual value in adding firmness to the fat.

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[2] Chilcott, E. C., J. S. Cole, and W. W. Burr. Barley in the Great Plains area: Relation of cultural methods to production. U. S. Dept. Agr. Bul. 222, 32 pp., illus. 1915.

MANURES AND FERTILIZERS

Most of the barley of the United States is grown outside the regions where the use of commercial fertilizers is common. Even barnyard manures are little used in the arid regions. It is likely that the extensive use of both commercial fertilizers and barnyard manures will be confined to the two humid regions for some time to come.

BARNYARD MANURE

Barnyard manure, when well rotted, is the best farm fertilizer. It not only supplies plant food but stimulates many desirable forms of bacteria found in the soil. It gives the soil a better texture and a higher moisture-holding capacity. In the humid-spring region it is best applied to the crop preceding barley, preferably corn. In this region the quality of barley often suffers from too much nitrogen, and the straw lodges easily. The addition of a nitrogenous manure causes a ranker growth, which usually results in lodging and difficult harvesting. In the South, where the soil is not so rich, manure plowed under in time to be well decomposed by seeding time is very beneficial.

COMMERCIAL FERTILIZERS

The use of commercial fertilizers for barley is limited to the eastern part of the United States. It is probable that profits could be obtained from their application in sections where it is not a common practice. It is improbable, however, that this is the most desirable way of investing such cash surplus as may be available west of the Mississippi River. The greatest need, of course, is in the South. Lime is the cheapest and most easily procured of the commercial fertilizers. It is not a simple fertilizer, like nitrogen, for instance, since it is applied to correct acidity and only incidentally to supply calcium. Many of the soils of the humid-winter regions are acid. The use of lime is common throughout the South. Lime can be more evenly distributed with a drill than by hand. In the Eastern and Southern States 1,500 pounds of burnt lime or 3,000 pounds of crushed limestone to the acre can be applied to advantage where lime is needed. The frequency of application depends both on the character of the soil and the nature of the crops grown. Some soils require an application only once in several years, and it is seldom that lime is required more frequently than once in three years. The application should be so timed in the rotation that clover and similar crops are grown upon recently limed soil, while rye and other acid-enduring crops are grown when the supply of lime is lowest.

Applications of lime are doubly important when barley is used as a nurse crop for red clover, which can not be grown on an acid soil.

The three elements usually supplied by the so-called complete fertilizers are nitrogen, phosphorus, and potassium. Nitrogen is commonly secured in nitrate of soda and ammonium sulphate or from such organic materials as tankage and cottonseed meal. Phosphorus is usually obtained in acid phosphate or the raw rock phosphate from which the acid phosphate is manufactured. Basic slag and bone meal, which contain phosphorus, are also widely used. The phosphorus in the acid phosphate is much more available than in the raw

rock. The acid form is to be preferred. Raw rock is best used in heavy applications in connection with green manure or in mixing it with stable manures some time before applying it to the field, or sometimes by a daily addition to the stable accumulations. If raw rock is used in complete fertilizer, the nitrogen can best be added in ammonium sulphate. Potassium can be secured as kainit and sulphate or muriate of potash.

In grain farming complete fertilizers are also used. The formula varies so with the nature and condition of the soil that exact proportions can not be given. Even the basis of the quantity removed by the various crops is not particularly significant, because one or more of the three elements in question may be present in abundance.

In general, for grain farming in the Eastern and Southern States a fertilizer approaching a 3–10–3 formula will be satisfactory; that is, a complete fertilizer with nitrogen, phosphorus, and potassium present in the proportions given.

The aim of every farmer, however, should be to avoid the use of a complete fertilizer. Fertilizers are expensive, and a proper handling of the farm enterprises may cut down their use materially. No farmer should find it necessary to purchase nitrogen. Nitrogen can be secured free from the air by the use of clover, alfalfa, cowpeas, soybeans, velvetbeans, or vetch. Any scheme of crop management should embrace one or more of these crops. The rotation mentioned earlier provided for supplying nitrogen by this means.

Potash is usually present in sufficient quantity, though not always available. Green manures and barnyard manures tend to make potash available. The same scheme that adds the nitrogen will ordinarily free sufficient potash for the needs of the crop. Phosphorus alone is the element that may need to be supplied direct to farms of the East and South. The more livestock enters into the management of the farm the less phosphorus will need to be added. The scheme of adding phosphate to the stable manure is ideal, but seldom sufficient. Only the most specialized of livestock farms produce enough manure to cover their entire area in any reasonable number of years. Green manures and legumes must supplement these applications; and to them, in certain areas, phosphates must be added to maintain a high productivity.

GOOD SEED

Good seed is an insurance that the crop makes its initial growth without handicap. It means a good deal more than merely seed that will grow. It means seed that will grow vigorously and mature a desirable sort of grain that is free from disease.

To obtain such seed it must be, first, a desirable variety. The varieties are discussed later. The seed must be from a field that was properly cared for the previous year. The grain should have been well matured and so shocked and stacked that it escaped weather and heat damage. Grain that has passed through the sweat in the stack germinates more vigorously and in higher percentage than that threshed and placed in the bin immediately after cutting. Weather damage in the shock seriously injures the vitality of the seed.

The grain should be free from weed seeds and diseases. Noxious weeds are often introduced on the farm through the seed. It is

much cheaper to pay a few cents a bushel more for certified seed than to use seed of doubtful character. It is better to get seed from clean fields than to treat it for diseases. Where diseases are present in quantity they should be treated or disease-free seed obtained.

Seed that is otherwise desirable often has a percentage of poorly developed kernels. These can be removed with a fanning mill. Good plants can sometimes be obtained from small seed, but they are likely to be weak and are usually crowded out. It is best to remove the lighter grain and use it as feed. The fanning mill while performing this function will at the same time remove many kinds of weed seeds.

PREPARATION OF THE SOIL

The ideal seed bed is one in which the bottom is firm but not too hard for the easy penetration of water and the growth of roots,

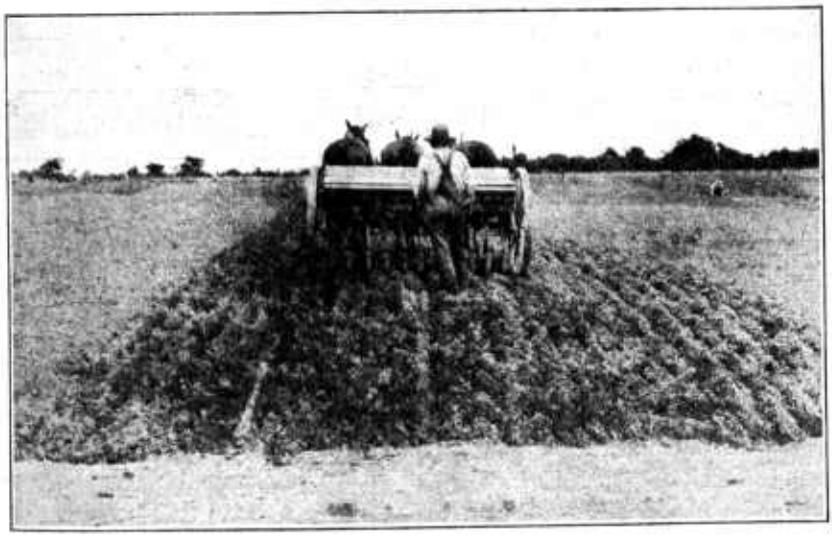

FIG. 3.—Drilling grain on a well-prepared seed bed

while the upper 2 inches are loose. The soil should be so firm that few grains will fall in spaces too large to secure the contact with moist surfaces necessary for germination and thus result in an uneven start. The right kind of a seed bed is shown in Figure 3.

The aim of the operations in seed-bed preparation is to approximate the ideal seed bed at the least possible cost. Very comprehensive data on seed-bed preparation in the Great Plains area have been published by the United States Department of Agriculture.[3]

The figures are not directly applicable to other barley-growing sections. The results are based on pre-war costs and prices and therefore are purely relative. The figures are so suggestive, however, that one of the tables is copied in this bulletin. (Table 3.)

Both production and profits are shown. These, of course, vary from day to day. The price used as the basis of cost computation

[3] See footnote 2, p. 8.

in Table 3 is 41 cents per bushel in the shock, or 47 cents per bushel for threshed barley. At that price disked corn ground was found to be the most profitable on the Great Plains. In the humid-spring areas disked corn ground or fall plowing is probably the cheapest. From the point of returns, fall plowing is best in this region. In the Dakotas preference is frequently given to wheat, and the barley crop is placed on late spring plowing, which is harrowed and sown at once. Necessity justifies this practice, as it is often the only possible way to put in a crop. When this is done, all the labor which can be given without sacrifice of acreage should be devoted to the reduction of the soil to a firm condition.

TABLE 3.—*Comparison of the average yields and profit or loss in the production of barley by different methods of tillage at 14 stations in the Great Plains area*

[Data according to Chilcott, Cole, and Burr. The profits and losses were based on pre-war prices for equipment and labor and a farm price of 47 cents per bushel for barley]

Stations	Number of years averaged	Methods of tillage						
		Fall plowed	Spring plowed	Listed	Sub-soiled	Disked	Green manured	Summer tilled
Yields per acre (bushels):								
Judith Basin, Mont.	5	24.0	24.0	29.0	30.5	29.0		30.2
Huntley, Mont.	2		29.6			34.5	43.8	
Williston, N. Dak.	5	17.4	16.1			27.5		28.8
Dickinson, N. Dak.	6	25.1	24.6			37.4		32.5
Edgeley, N. Dak.	8	16.7	18.5			23.4		20.0
Hettinger, N. Dak.	3	19.9	25.5			14.9		31.8
Belle Fourche, S. Dak.	6	7.6	8.3	7.7	8.0	12.2		12.6
Scottsbluff, Nebr.	2	14.0	15.4	14.4	15.0	18.6		27.6
North Platte, Nebr.	8	17.1	15.9			13.4		26.7
Akron, Colo.	6	18.6	18.8	17.9	14.0	18.4		24.8
Hays, Kans.	6	13.6	11.2	12.7	14.6	14.1	15.5	19.3
Garden City, Kans.	5	6.9	4.3	8.3	6.9	8.9		11.0
Dalhart, Tex.	4	3.9	1.9	4.4		1.6		6.4
Amarillo, Tex.	6	8.2	5.7	6.1	6.8	6.6		12.6
Profit or loss (—) per acre:								
Judith Basin, Mont.	5	$3.38	$3.85	$6.44	$5.44	$7.24		$0.98
Huntley, Mont.	3		6.15			9.50	$3.45	
Williston, N. Dak.	5	.67	.61			6.63		.41
Dickinson, N. Dak.	6	3.83	4.10			10.68		1.93
Edgeley, N. Dak.	8	.39	1.60			4.94		−3.20
Hettinger, N. Dak.	3	1.70	4.47			1.46		1.64
Belle Fourche, S. Dak.	6	−3.34	−2.59	−2.29	−3.79	.35		−6.23
Scottsbluff, Nebr.	2	−.72	.32	.45	−.92	2.98		−.08
North Platte, Nebr.	8	.55	.53			.84		−.55
Akron, Colo.	6	1.17	1.72	1.89	−1.33	2.89		−1.23
Hays, Kans.	6	−.88	−1.40	−.24	−1.08	1.13	−8.15	−3.49
Garden City, Kans.	5	−3.63	−4.23	−2.05	−4.24	−1.00		−6.89
Dalhart, Tex.	4	−4.86	−5.21	−3.65		−3.99		−8.78
Amarillo, Tex.	6	−3.10	−3.65	−2.95	−4.28	−1.94		−6.23

In California plowing is usually delayed until the fall rains begin. Much of the sowing is on land that is plowed in January or February and even in March. The seed bed is frequently far from ideal. After summer fallow the seed bed is good and needs no modification. In fall plowing, advantage should be taken of all the early rains and a seed bed prepared as early as possible. The disk can be used after the first rain and the ground made more receptive and the plowing easier. The custom of volunteer crops should be discontinued. Disked land should be used only when there is not time for plowing, as early seeding is an important consideration in California except on subirrigated lands.

In the South winter barley is seeded after a variety of crops. Although good results are sometimes obtained after corn, that crop is too late in maturing to prepare the soil for the best time of seeding. For this reason it is not advised. If seeded after corn, a disk is the best implement for preparing the seed bed.

When barley follows a small-grain crop the land is frequently plowed immediately after harvest and allowed to lie fallow until fall. Cowpeas can be grown to advantage after winter grain and turned under as green manure. In this case the ground should be plowed some time before seeding, to allow it to settle as much as possible. If the pea crop is removed for hay, disking is preferred to plowing.

DATE OF SEEDING

The maximum returns from barley are obtained when the crop is seeded early. The fact that spring barley can be seeded late and still mature a partial crop has led to considerable abuse of the latitude that its early maturity makes possible. It is the common practice to seed barley after the seeding of oats and spring wheat has been completed. From the farm standpoint this practice is justified by the requirement that the oats and wheat must be sown early. From the standpoint of barley culture, it is not good practice and results in reduced yields. As a matter of fact, spring barley should be sown at about the date generally observed for sowing spring wheat if the best results are to be obtained. In certain localities where the spring opens late this is not always possible, but the losses arising from late seeding should be realized and all efforts made to hasten the spring work. Large grain farms, such as are found in North Dakota, present the most difficult problems. The work on all crops falls in a very short period, and if weather conditions are adverse it is not physically possible to complete the seeding during the period when the best results are to be obtained. It has been shown [4] that the period of barley seeding in North Dakota extends over 25 days, whereas in Wisconsin the seeding is accomplished in 16 days. This means that in Wisconsin barley is a primary crop, grown on farms so small and so diversified that the farmer grows it for the sake of the barley crop and is able to seed it near the proper time for seeding barley. In North Dakota, on the contrary, barley is seeded when the wheat and oat seedings permit. In Wisconsin the greater part of the crop is seeded during the most favorable period. In North Dakota most of it is seeded later than this period.

Of course, there is variation from season to season, but, in general, barley should be seeded as early as the ground can be worked well in the spring. If the soil is of a heavy, cold character it should be seeded a little later than the lighter soils, as the soil must have some warmth at seeding time. The recommendation of early seeding should not be followed to such an extreme as to plant the grain in a backward spring in soil that must be worked wet to prepare it for such an early date. Neither should the ground be allowed to remain weedy in order to hasten the date. On the other hand, no time should

[4] Covert, J. R. Seedtime and harvest: Cereals, flax, cotton, and tobacco. Dates of planting and harvesting east of meridians 102–104 in the United States. U. S. Dept. Agr., Bur. Statis. Bul. 85, 152 pp., illus. 1912.

be lost when the ground can be worked with safety, especially if it has acquired some warmth. On the northern Plains, the most favorable period is from April 1 to April 25. Figure 4 indicates the yields according to time of seeding in Montana, North Dakota, and South Dakota, from data made up from the experiments at a number of stations. In only one instance at one station did the earliest date produce less than the maximum yield. After April 20 the yields began to be somewhat less, and in no case did seeding as late as the first of May produce a maximum yield. The loss after April 25 is more than 1 per cent a day. These tests were all in well-prepared seed beds, and it is possible that the earliest seedings on soil that is less well prepared might not produce results as favorable as those here shown. It is certain that the falling off in yield would show as quickly on any seed bed, owing to less favorable climatic conditions during the ripening period.

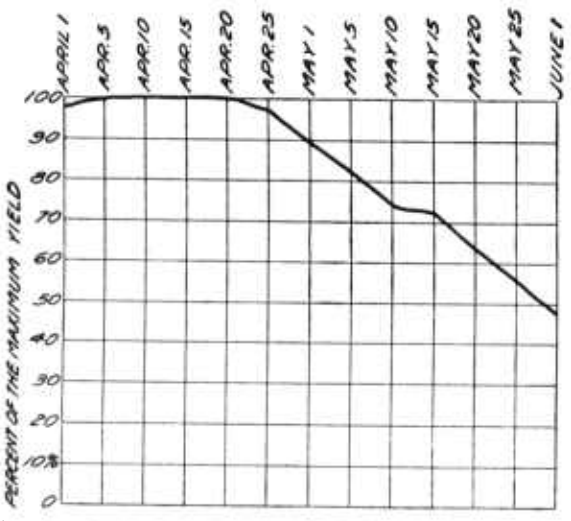

FIG. 4.—Diagram showing the percentage of the maximum yield that has been obtained on various dates of seeding at field stations in North Dakota, South Dakota, and Montana. Seeding later than April 25 has resulted in a loss of more than 1 per cent for each day that seeding was delayed. Seeding the last of May has given only about 50 per cent of the maximum yield. In southeastern Minnesota and Wisconsin the best date to seed is correspondingly earlier

The loss of at least 1 per cent a day after April 25 must be reckoned as a probable average for a series of years. This means that on a field of 50 acres of barley which if seeded in time would yield 30 bushels per acre there is a loss for the field of at least 15 bushels a day for every day that seeding is delayed beyond April 25. This is the average date for these States. In Montana and the extreme northwestern portion of North Dakota the date is three or four days later, and in some parts of South Dakota it is three or four days earlier. The variation is not as much as would be expected. The seasons in southern Minnesota, Iowa, and Wisconsin are slightly earlier, and the consequences of late seeding are more disastrous than in the case of the other States mentioned. Seeding as late as the first of May in southern Minnesota and Wisconsin is to be discouraged. In New York and New England the cool summer permits a slightly later seeding. In Oregon and Washington spring-sown barley should be put in as early as possible. In California data collected by G. W. Hendry show that early seeding (before December 20) produces the maximum yields, whereas late seeding (after January 25) shows a yield more than 20 per cent less than the earlier date.

In the Southeastern States winter barley must be seeded early. September seeding has given good results at most places in the barley-producing area. In the southern edge of the humid-winter belt October seeding is frequent.

RATE OF SEEDING

The best rate of seeding barley varies widely with the season, and maximum yields are obtained at rates covering a wide range. A single plant accommodates itself to its individual conditions. If it is crowded by other plants it produces only one or two culms, but

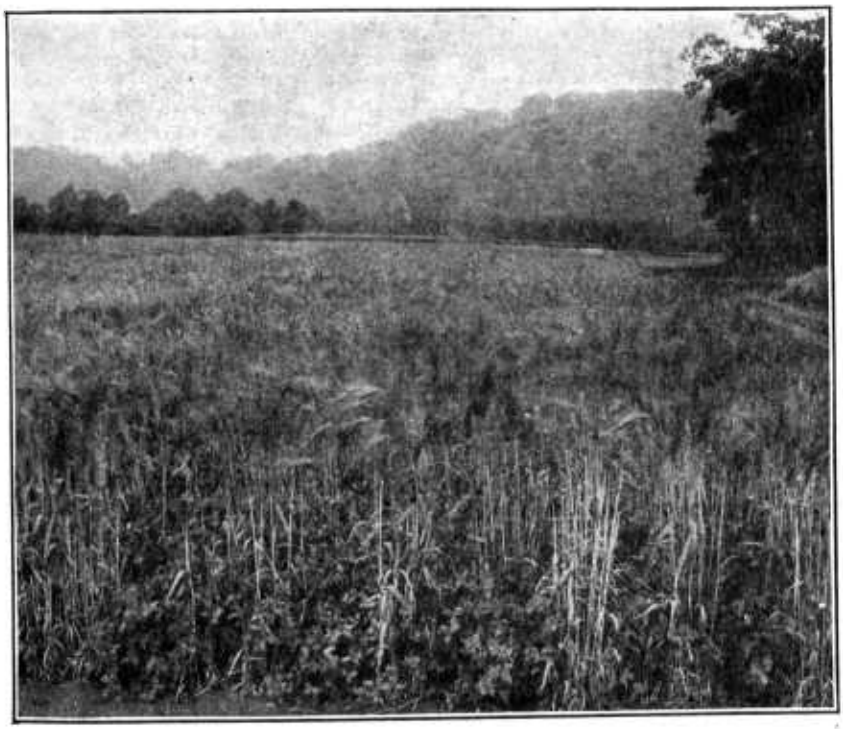

FIG. 5.—A field showing winter barley as a nurse crop for red clover

in an open space it may produce several. The best rates are usually heavy enough to insure that the thinnest spots on the field will have enough plants for a maximum yield. In the humid regions this maximum under favorable conditions might be obtained with a seeding of 5 pecks per acre, yet at the same time 10 pecks per acre would not decrease the yield. As the seed bed is not usually perfect and as adverse weather conditions subsequent to seeding may decrease the stand, 2 bushels per acre are usually seeded in the humid sections. On the northern Plains 4 pecks per acre have given about the same returns as 8 pecks. Four to 6 pecks are usually recommended. Six pecks are too much in the driest years and in localities where the average season is known to be severe. Four pecks are recommended

for such places. In other parts of the northern Plains, especially along the eastern limit, 6 pecks may often be sown to advantage, though it is usually more than is necessary if the seed bed is in prime condition. In the very driest localities of the Dakotas and Montana and in the Great Basin, 3 pecks are sometimes seeded to advantage. In California 7 pecks per acre are usually seeded. In the winter-barley districts of the Southeastern States 8 pecks are recommended. Where a naked variety is grown, not more than three-fourths of the rate for hulled barley should be sown. Where barley is grown as a nurse crop, about 25 per cent less grain should be seeded than for a grain crop, as a thin stand allows a better growth of forage plants, a good stand of which is shown in Figure 5. When grown for pasture, the rate should be increased 25 to 50 per cent.

DEPTH OF SEEDING

The seed of barley should be placed in the ground at such a depth that it can get both moisture and air. In the humid regions, if planted too deeply, excessive moisture may shut off the air supply and reduce the temperature to the extent of decreasing the germination. In the arid region too shallow planting may result in poor germination through lack of moisture. In the humid regions the best conditions are found at a depth of about 1½ inches. On the northern Plains this should be increased to 2 inches. In the Great Basin the best depth is from 2½ to 3 inches. At Nephi, Utah, 3 inches was found to give the best results for the depths tried, but no seeding was made at 2½ inches.

METHOD OF SEEDING

Drilling with a grain drill is the best method of seeding barley. The drill is constructed for the purpose of placing every seed in the most favorable location. For this reason it is much more economical of seed than broadcasting. Under favorable conditions of soil and moisture, broadcasting may produce yields as high as those obtained from drilled seed. As the conditions become adverse, the results are more and more in favor of drilling. In the drier regions the grain must be placed at some depth beneath the surface to secure an even germination. This can not be done uniformly by any means except the drill. Any good grain drill will do the work successfully on a well-prepared seed bed. If the ground is covered with trash, as disked corn ground, the single disk drill is to be preferred.

Broadcasting should not be practiced where it can be avoided. It is particularly undesirable to broadcast seed on dry ground, as part of it may be harrowed in deep enough to germinate, while the rest may lie for days awaiting a rain to start growth. This results in a very uneven stand. In moist soil, under favorable conditions, broadcasting is not so objectionable. In the interior valleys of California where the plowing, seeding, and harrowing must be done quickly, before the rains begin, broadcasting is often employed to save time. Even there, although conditions are unusually favorable to broadcasting, better results are obtained with a drill, and where the ground is in suitable condition and sufficient equipment is available to seed the acreage without delay a drill should be used.

TIME OF HARVESTING

The time of harvesting barley depends on the use of the crop, the variety, the climate, and the method used.

For seed, brewing, or feed, the crop should be mature. The maturity should not be judged by the earliest spikes. If possible the latest spikes should be mature, as this will insure that no part of the crop will be shrunken from having been harvested too soon. If the stand is thin or uneven this may not be possible, as the earlier spikes of many varieties would begin to shatter. By maturity is meant the point where material ceases to be added to the kernel and not that the grain has become bin dry. There are several popular tests which indicate this period. The kernel at this time can be dented with the thumb-nail and retains the dent for some time. The milky juice largely disappears from the furrow. The hull begins to wrinkle on the ripest grain, showing the shrinkage of the kernel beneath. After this point is reached, ripening is merely the loss of moisture and can take place in the shock as well as if the crop is left uncut.

Nurse crops of barley are often cut somewhat earlier than grain crops, but this is for the purpose of favoring the development of the grass seeded with the barley and does not enter largely into the general problem of barley harvest.

As a hay crop barley is harvested still earlier. It is not cut while in bloom, however, as is customary with many of the grasses. The grain is allowed to develop almost to its maximum. The grain content of barley hay constitutes a considerable part of its feed value. Barley is highly prized as a hay crop in the West, despite the coarse awns which frequently cause sore mouths in horses and cattle. Sometimes the hooded varieties are grown for hay in order to eliminate this objectionable factor. Much of the hay, however, is incidental; that is, the barley is sown for grain. If the season is favorable, it is harvested for grain; if unfavorable, it is harvested for hay.

The time to harvest sometimes depends on the variety. Some varieties shatter badly when ripe, while others do not. Hooded and awnless sorts shatter most easily. The Coast type (Bay Brewing, California Feed, etc.) shatters much less than the other types. The types which shatter must be harvested promptly. The best of the Coast type can be left until the full maturity of the latest culms and suffers but moderate losses for some time after complete dryness.

The climatic conditions at the time of harvesting have some influence on the stage at which barley is cut. In a section subject to storms the harvest must be accomplished within a very few days. If the straw is too green it will not dry properly in a humid climate, and there may be mold damage. If harvest is delayed too long, much grain might be lost through the occurrence of a storm, as all barleys in humid climates shatter rather easily. In the arid region green barley dries readily, and storms are not so common as to cause shattering in the overmature crop. The varieties in the arid regions outside the Great Plains do not shatter readily.

METHODS OF HARVESTING

There are but three common methods of harvesting barley—by the use of the binder, the header, or the combined harvester. The

grain binder is the implement of the intensive farmer and is by all means the best, where it can be used. The grain can be cut with less loss. It can be cut at the optimum time and in the humid regions can be stored with less damage than by the other methods. When cut with the header or the combined harvester, the grain is allowed to ripen more completely than when cut with the grain binder.

The header is important in the Plains region, where it is a rapid means of harvesting large acreages. It is very useful in harvesting crops where the straw is too short for the best use of the binder. Some varieties, such as the White Smyrna, are very difficult to harvest with a binder, on account of their short straw. The common use of the combined harvester is confined to the Great Basin and California.

When the combined harvester is used the grain must be ripened to dryness. In California the crop often stands three weeks after maturity before being cut. Only varieties of the Coast and Mariout types are suitable for this practice. None of the other common varieties will stand after they are ripe without losing a large part, probably the greater part, of the grain. In California, in a total yield of 31.1 sacks per acre there was a loss of 6.6 sacks per acre when the combined harvester was used, whereas only 1 sack per acre was lost when the grain binder was used.[5] This loss of 1 sack included the loss at the thresher. The loss of the crop by the use of the combined harvester was 21 per cent, while that of the binder was 3 per cent. Professor Hendry states that although it might be held that the shattering loss was unusually high in this case because the yield was above the average, observations made in various parts of the State would indicate that the contrary is true and that the percentage of shattering is usually higher in the case of the lower yields. He also states that while the cost of production is lower with a combined harvester, the net proceeds are in favor of the use of the grain binder.

The grain lost by shattering is sometimes allowed to volunteer for the next crop. This practice is not to be recommended, as it is unprofitable.

SHOCKING, STACKING, AND THRESHING

Grain is usually shocked after being cut by the binder. The object of shocking is to protect the grain as far as possible until it is threshed. The treatment of course varies with the climate of the section. The more humid the section, the more trouble is experienced in safely harvesting the crop. Weather is the main source of shock damage. The shocks should be built with this in mind. If the straw is not quite dry, oblong shocks without caps are best. If the section is one where windy weather prevails, the grain may be left in this form of shock until stacked or threshed. In the rainy districts, winds permitting, these oblong shocks should be changed to the round type and capped when dry. Ordinarily, of course, the grain is dry enough to put in a round shock and capped at once. After heavy rains, if the shocks have become wet inside they must be opened and the bundles spread out to dry. The bundles should be

[5] Hendry, G. W. Harvesting grain in California. The combined harvester v. the grain binder. *In* Univ. Calif. Jour. Agr., v. 3, pp. 129–137, illus. 1915.

laid across one another in such a way as to keep the heads off the ground.

The grain should stay in the shock as short a time as possible. Rain is certain to discolor and injure the cap sheaves. If the bundles become wet enough to require spreading, most of the grain will be discolored, at least. There are various species of fungi that aid in the discoloration, and if the grain remains moist any length of time odors of mold will persist after threshing. Discoloration and mold odors greatly lessen the price when the grain goes on the market as malting barley. Weather damage, aside from the direct loss of germinated grains, affects the viability of the seed and its value for seed and malting purposes. For these reasons the grain should be either stacked or threshed as soon as possible after it is cut. Stacking gives the finest quality of grain for seed or malting. The grain goes through the sweat in the stack, which seems to increase the percentage and vigor of germination. Sweating also occurs in bin grain threshed from the shock soon after cutting. Bin sweating is not as normal as that in the stack, and there is some danger of heating. There is some loss of weight in sweating, and properly cured barley should bring a higher price than grain direct from the field. It costs about 1 cent per bushel more to stack grain than to thresh from the shock. When grain is stacked the work should be carefully done and the stacks made in such a way that they shed water perfectly. Poor stacking may result in large losses. Unless skilled labor is available, it is better to stack under sheds or other shelters if it is possible to do so.

Barley must be threshed carefully. About one-eighth of the crop is used for malting. Its value for this purpose can be greatly affected by improper threshing. In the process of malting, barley is germinated at temperatures and in a humidity favorable for fungous growth. The grains are protected by a heavy layer of cells that surround the starchy interior. If this layer is injured the fungi gain entrance and feed upon the material stored in the grain. Injury in threshing comes about in two ways: (1) Many kernels are actually broken in half, and (2) many others are threshed too close. Close threshing breaks off the tips and exposes the body of the grain to attacks of fungi. The concaves should be so set as to avoid these injuries.

COST OF PRODUCING BARLEY

The cost of producing barley varies with the section of the country, the cost of man and horse labor, the price of seed, and the amount of capitalization. These items themselves vary from year to year in any section. At present the cost is considerably higher than it was before the war.

In Table 4 is given a compilation of the data published by several investigators.[6] Their work represents three general areas which present marked differences of economic conditions and cultural practices. The farms of the humid-spring region, where land values are high and the agriculture more or less diversified, are

[6] See footnote 2, p. 8.
Peck, F. W. The cost of producing Minnesota farm products, 1908–1912. Field crops. Minn. Agr. Exp. Sta. Bul. 145, 48 pp., illus. 1914.
Hendry, G. W. Op. cit.

represented in the Minnesota averages. On the Great Plains, land values are low, with grain farming the main enterprise. In California, land values are about the same as in Minnesota. The barley is raised on farms devoted almost exclusively to grains and is usually harvested with the combined harvester. All figures are of the prewar period.

TABLE 4.—*Pre-war cost of producing an acre of barley in three representative sections of the United States*

Locality and method of preparation	Method of harvesting	Preparation of land	Seed	Seeding	Cutting and shocking	Interest, taxes, depreciation, and general expenses [1]	Total cost of grain in shock	Stacking and threshing	Total cost, threshed grain
Minnesota: [2]									
Fall plowed	Binder	$2.08	$1.58	$0.31	$0.81	$5.37	$10.15	$1.93	$12.08
Great Plains area: [3]									
Disked corn-land.		.97	.75	.40	.93	1.60	4.65		
Listed		1.77	.75	.40	.93	1.60	5.45		
Spring plowed		2.31	.75	.40	.93	1.60	5.99		
Fall plowed		2.78	.75	.40	.93	1.60	6.46		
Subsoiled		3.39	.75	.40	.93	1.60	7.07		
Summer tilled		6.12	.75	.40	.93	3.20	11.40		
California: [4]									
Fallow	Binder	1.75	1.00	.40	1.55	11.17	15.87	4.30	20.17
Do	Combined harvester	1.75	1.00	.40		11.17		[5] 3.40	17.72

[1] The sums given in the column of interest, etc., in the case of the Great Plains area include only interest and taxes and not depreciation and general expenses.
[2] Average of farms in three localities during the years 1908 to 1912, inclusive, according to Peck.
[3] Average of eight stations in the Great Plains area during the years 1909 to 1914, inclusive, as given by Chilcott, Cole, and Burr.
[4] Cost based on a 31-sack crop in 1915, according to Hendry.
[5] Harvesting (cutting and threshing).

In Table 4 some liberties have been taken with the figures of the various investigators. Hendry's figures, for example, were originally a comparison of the two methods of harvesting. He carries the cost to the place where the barley is in the warehouse. In the cost of threshed grain he includes sacks. These are omitted here because the figures would not then be comparable with those of the other investigators. As far as California is concerned, they should be included. Hendry's total cost in the warehouse was $22.79 for the combined harvester and $26.13 for the grain binder. Much of the extra cost of the binder comes from the extra quantity of grain handled, 5½ sacks more being obtained by the use of the binder than by the use of the combined harvester. The net profit per acre is greater with the grain binder.

In the cost per acre of grain in the shock the variations are of interest. The grain in the shock is the fairest point of comparison, as Chilcott, Cole, and Burr do not carry their figures farther. The overhead charges of Peck are just about half those of Hendry. In Minnesota a crop is raised every year, whereas in California a crop of 31 sacks could not be expected except when the land was fallowed every alternate year. The overhead charge of Chilcott, Cole, and Burr on the Great Plains is low, owing to low land values and to the inclusion of part of the depreciation in the labor cost. The overhead charge is the largest single item and the one commonly ignored by

farmers who own their own land and equipment. Farmers usually figure their profit without considering either the interest on their investment or their own labor. In most of the barley-growing districts a satisfactory margin exists between the cost of production and the cash returns. From the current price of barley the number of bushels necessary to meet the cost of production is readily computed. It is the grain in excess of this quantity that constitutes the profit of the farmer. As the cost of farm labor and materials advanced greatly during the war the farmer must add this extra cost in making estimates at present.

USES OF BARLEY IN MANUFACTORIES

The market price of barley depends in part on its suitability for the use to which it is to be put. The present factory demands are: A reduced demand from domestic maltsters, an export demand for malting barley, and the normal market for pearling, breakfast-food preparation, and flour. The maltsters require a clean, well-matured, undamaged grain of high viability. Damage may result from either harvest, shock, bin, or threshing injury. Barley that is cut too soon—that is, before the grain is really mature—is usually classified as harvest-damaged grain. Shock damage arises from adverse weather conditions. This has been previously considered. Bin damage comes from the storage of moist barley or from leaks after storing. On the farm about the only remedy for bin heating is shoveling the grain to another bin when it heats. If floor space is available, spreading it out over a large area and shoveling it over every day or two will save very moist grain from injury. In elevators it is comparatively easy to aerate grain by running it into another bin. Musty barley makes musty malt and musty malt carries objectionable flavors into the malt liquors when used for that purpose. Threshing injuries promote the growth of molds in the germinating chambers.

Barley that is raised for malting should be of the variety or at least the type common to the region, unless previous arrangements have been made with the buyer and there are facilities for keeping it separate. A mixture of types is a sure cause for a decreased yield to the maltster. Different types germinate differently and can not be malted uniformly when mixed.

Pearled barley is made by the removal of the outer portions, leaving a round pellet which is free from hulls and bran. Barley for this purpose must be free from weather damage and unbroken, as it is impossible to pearl a broken kernel. The larger and more nearly spherical the kernel, the more economical is the process and the better the product. For these reasons large-grained 2-rowed varieties are grown for pearling. The best variety is the Chevalier. This variety can be grown well in Montana and the Great Basin under irrigation and sufficiently well in the delta lands of California. Where the Chevalier does not grow well, the Hanna may be substituted.

Most barley breakfast foods are made from malt. Their requirements, therefore, are those of malting barley. If naked barley were grown in large enough acreages in definite localities, it is possible that a better market for it might be secured for special purposes.

Barley flour is new to this country, but the experience of 1917 has shown that in cases of wheat shortage it is a valuable reserve flour grain. Barley is usually seeded later than wheat and interferes little with the wheat acreage. It is a protection to our wheat supply, in case it is needed as a substitute for wheat flour. It can be milled by wheat mills and produces more pounds of flour per acre than wheat.

Barley flour when used alone does not make good raised bread. It can be mixed up to 20 per cent with wheat flour without detriment to the quality of the bread. For hot breads where baking powders are employed 80 per cent of barley flour may be used.

The future of barley flour in America depends to a considerable degree upon other factors than its nutritive and baking value. Unquestionably barley flour is nutritious, and it mixes very well with wheat flour in the making of bread. The addition of barley flour darkens the loaf, and this is the main obstacle to its regular use. The American housewife prefers a white bread, even at the expense of some food value. Although barley will not make as white a loaf as wheat, the desire for light color can be partially met by careful milling and the use of selected varieties.

Undoubtedly the first barley milled in this country was of too high extraction to be permanently satisfactory. The flour was nutritious and probably contained a large proportion of desirable mineral elements, but the dark color caused dissatisfaction. As high as 70 per cent of flour was often obtained, when the percentage from the trade standpoint should have been not more than 60 per cent and probably should have been less. Machinery or methods that completely eliminate the glumes and other enveloping tissues before or after grinding will doubtless add much to the appearance of the flour. In using the so-called blue varieties it may be necessary to remove the aleurone layer as well.

Some varieties are better suited than others for milling. Less waste occurs with large-grained varieties than with small-grained ones. If grown for milling, the sorts with white aleurone layers are preferable to those with blue aleurone layers. The Chevalier is perhaps the best variety for milling that is grown extensively at present. The White Smyrna and Hannchen are suitable varieties, adapted to certain sections mentioned elsewhere. Until there is a definite market preference which carries with it a noticeably higher price per bushel, the farmer can not be expected to sacrifice high-yielding varieties for those less well adapted. Where large-grained varieties with white aleurone layers produce as much as those with smaller grains or blue aleurone layers, the farmer may readily anticipate the demand by seeding them in preference.

STOCK FEED

The value of barley as a feed is not appreciated by the eastern farmer. In the West where corn is not grown, barley is utilized and is fed understandingly. In the humid region its possibilities have been so obscured by the habit of corn feeding that barley is hardly considered in livestock farming. On account of the high acre yield of corn, barley can not compete with corn where labor is sufficient to make corn the exclusive grain crop. Where small grain is grown as a part of the farming program, barley is often the most profitable.

The sections where this is likely to be the case are indicated on the map (fig. 2). Where grain is to be purchased to supplement the farm production, barley by all means should be considered. Pound for pound, its relative value is shown in Table 2. Its value as a feed is not entirely revealed in the table, since the suitability of different grains to different classes of livestock does not depend entirely on their chemical composition. Oats, for instance, are unsuited to the feeding of pigs because of the large amount of hull. Barley, on the contrary, can be used with success and is especially prized for the production of bacon. Barley, on account of its high protein content, is usually better for growing stock than corn, whereas corn is usually superior for a fattening ration. The following statement[7] indicates the value of barley as a feed:

On the Pacific slope, where corn or oats do not flourish in equal degree, barley is extensively used as a feed for animals. The horses of California are quite generally fed on rolled barley, with wheat, oat, or barley hay for roughage. Barley is the common feed for dairy cows in northern Europe. The Danes sow barley and oats together in the proportion of one part of barley to two of oats, the ground mixed grain from this crop being regarded as the best available feed for dairy cows and other stock. Fed with legume hay to fattening steers and lambs, barley has given nearly as good returns as corn. For horses, barley is somewhat less valuable than oats. At the Virginia station,[8] calves made excellent gains on barley and skim milk, but corn proved cheaper. In Great Britain and northern Europe barley takes the place of corn for pig feeding, leading all grains in producing pork of fine quality, both as to hardness and flavor. In American trials somewhat more barley than corn has been required for 100 pounds gain with fattening pigs. * * * Though barley is somewhat higher than corn in crude protein, it is still decidedly carbonaceous in character and should be fed with legume hay or with a nitrogenous concentrate for the best results.

The food value per acre for barley has been indicated in Table 1, in which the pounds per acre have been multiplied by the percentages of protein and carbohydrates to show the pounds of digestible nutrients. Corn, on account of the high yield, gives higher returns than barley in the sections where corn can be grown.

FEEDING BARLEY

Success with barley depends in part on how it is fed. Barley fed whole is too hard for the best results, as much of it remains undigested. If barley is finely ground it makes a pasty mass in the mouths of the animals, which is evidently disagreeable, since they consume much less grain and consequently put on less flesh. The grinding machinery should be so set that the grain is merely cracked and not ground to the fineness of meal or flour. Where it can be done, a desirable method of preparation is rolling. Rolled barley is used throughout the West and should become common in the upper Missouri and Mississippi River valleys. In the latter regions the feeding of barley is much less common than it should be. Throughout this area barley is easily grown and can readily furnish the grain feed in a better balanced system of farming. It is desirable that a greater number of livestock be kept on the farms. Grain farming at usual prices is yielding gradually decreasing returns on

[7] Henry, W. A., and F. B. Morrison. Feeds and feeding. A handbook for the student and stockman. Ed. 15, p. 162. 1915.

[8] Fain, J. R., and M. P. Jarnagin. Grains to supplement skim milk for calves. Va. Agr. Exp. Sta. Bul. 172, pp. 83–94. 1907.

some of the best farming lands, and it has been extended into regions where it is not and probably can not be made continuously profitable. The hope of improvement in each case lies in livestock. For adequate livestock husbandry a carbonaceous grain is necessary. Much of the area is beyond the limit of corn for grain, though it is profitable for silage. Barley has a real place in establishing this area on a firm economic footing.

Barley is a good grain feed; cracked barley is better, and it is believed that rolled barley is still more desirable. The rolled product is shown in Figure 6. Any pair of heavy rolls will do the work. In the West there are large central mills which roll barley for a moderate charge. In these large mills the grain is steamed by a jet of live steam entering the stream of barley just before it reaches the rolls. The steam does not have time to penetrate the grain, which is

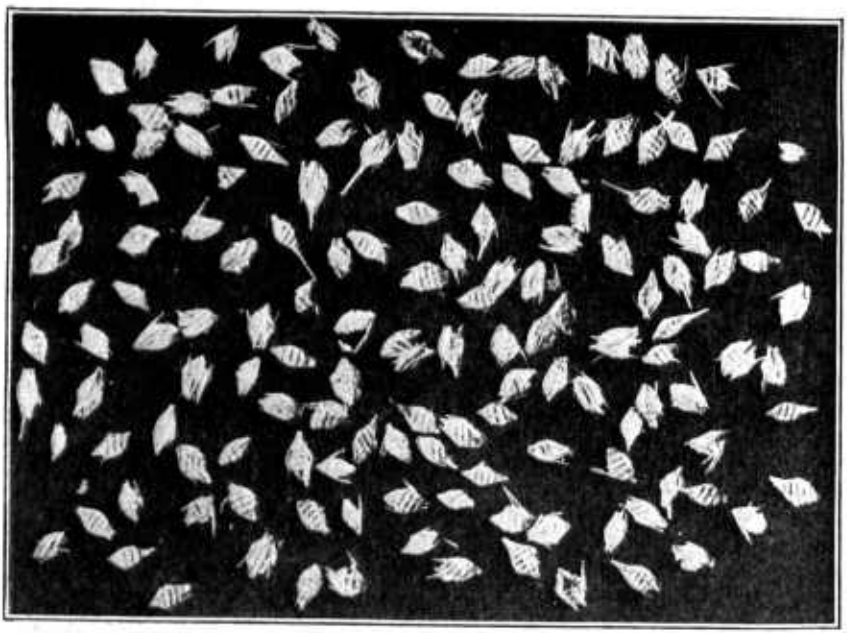

FIG. 6.—Rolled barley: A common way of preparing barley for feed in the West

in no way cooked or wet but merely moistened. The moisture thus added prevents any disintegration of the kernel and causes it to be merely flattened.

There are small outfits on the market for rolling barley on the farm. In these there is no provision for steaming, and the product is in consequence not so desirable. Such outfits, however, may prove especially useful in the humid sections of the United States, where steaming might lead to storage difficulties.

PASTURING BARLEY

Winter barley is sometimes used for pasture in the South, but is of minor importance compared with winter oats or rye. When intended for this purpose, it should be seeded earlier than for a grain crop, so that the plants may become well established before the first

cold weather. A heavier seeding than for a grain crop is desirable. Drilling is preferred to broadcasting. Barley is also used occasionally as a cover crop in this region.

VARIETAL REGIONS

The varieties of barley grown are grouped readily on the basis of the regions of production indicated on the map (fig. 1). Although some of the varieties that do well in the humid-spring area can be grown successfully in the semiarid regions, those typical of the semiarid region do not do well under humid conditions. Barley from neither of these regions does well in the humid-winter region. Each of these three regions is characterized by a predominating commercial type that is more or less well adapted to the whole area and that is almost certain to yield well wherever planted. In present practice the outstanding variety of the semiarid region is the Coast barley (sometimes known as California Feed or Bay Brewing), but it is not the most promising sort on the northern Plains. The characteristic type of the spring-humid region is the Manchuria-Oderbrucker. The Manchuria and Oderbrucker varieties, although of different origin, are very similar, and as neither is pure they are usually indistinguishable in the field. The best-yielding type in the humid-winter area is the Tennessee Winter. None of these types is a pure variety, and in each case high yields are obtained from their close geographical relatives when these are similar in type and source. These three types are shown in Figure 7.

FIG. 7.—Spikes from the predominating variety of barley in each of the three climatic regions: *a*, Coast (semiarid); *b*, Manchuria (humid spring); *c*, Tennessee Winter (humid winter)

The Coast variety is a 6-rowed barley composed of many similar strains. In the typical strain the glumes are white, while the aleu-

rone layer shows a blue tinge. All are large grained, of relatively low nitrogen content, and possess harsh awns which do not break off readily in threshing. Owing to the fragments of awns which cling to many kernels, the grain does not run through the drill readily; and the drill therefore should be set at a somewhat heavier seeding rate than if Manchuria, for example, were to be used. The Coast barley probably came from North Africa, most likely through Spain. Wherever the Coast variety does well, other North African barleys do well. South American sorts, which doubtless were introduced into South America from Spain, yield well in the semiarid region. One such has been grown to a small extent under the name Peruvian.

As previously remarked, the Manchuria and Oderbrucker barleys of the humid-spring region are very similar. Both are nodding

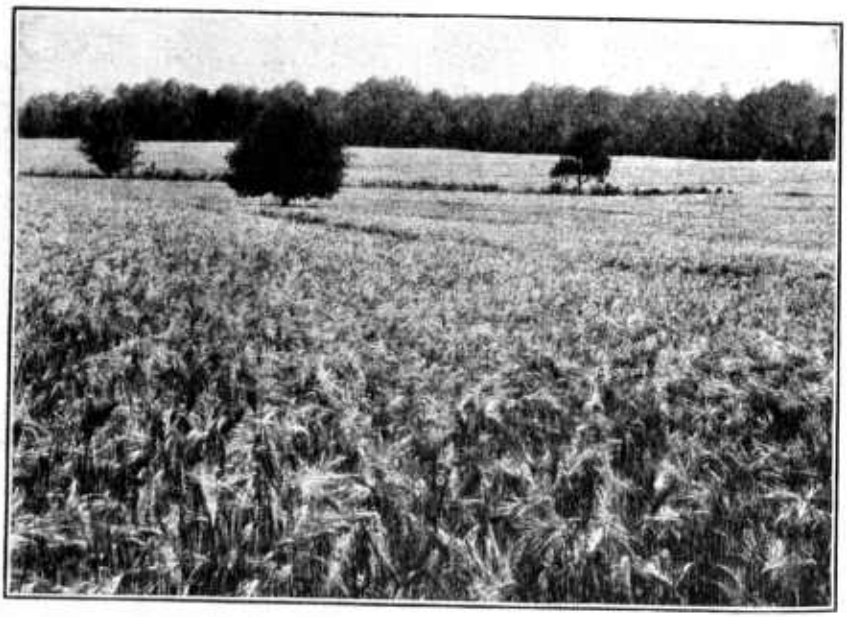

FIG. 8.—A field of Tennessee Winter barley

6-rowed forms having smaller kernels and more slender spikes and beards than those of the Coast barley. As in the Coast, they represent a type and not a pure variety. In each may be found white and blue-tinted strains. In field culture there is more blue in the Manchuria barley than in the Oderbrucker, and many of the selected strains of Oderbrucker are taller than the Manchuria. They have become so mixed that the original character of either is not easily determined. Selections of the Manchuria barley predominate in Minnesota and the Dakotas, whereas Oderbrucker selections are more commonly grown in Wisconsin. Although the Oderbrucker came from Germany, it probably has a common ancestry with the Manchuria. The only close relatives of the Oderbrucker and Manchuria barleys in farm culture are the Manshury and Scotch. The term "Manshury" is only a corruption of Manchuria, and the variety is

not a separate sort. The Scotch was formerly common in the districts now growing Oderbrueker, to which it is very similar.

The Tennessee Winter barley is similar in appearance to the Manchuria. It has three or four more or less indistinguishable companion varieties. The Maryland Winter and Texas Winter are probably identical with it. Professor Mooers, of Tennessee, states that the Union Winter differs constantly from the Tennessee Winter in time of heading and ripening. A field of the Tennessee Winter variety is shown in Figure 8.

VARIETAL AREAS

In each of the three great regions may be found minor areas to which some particular variety or strain is especially adapted. The semiarid region presents more of these localities than either of the others, as would be expected from its diversity of climate. On the northern Plains, 2-rowed varieties succeed better than 6-rowed. In northeastern Colorado, western Nebraska, western South Dakota, and western North Dakota, Hannchen has proved very dependable. This is a narrow, nodding, 2-rowed barley. Many of its awns fall off about ripening time. In Montana on dry land the White Smyrna variety is coming into favor. It is also grown some in Wyoming and in the Great Basin. It is a 2-rowed variety, extremely short strawed and with a very large grain. It is often cut with difficulty with a binder, but is harvested readily with a header. The first impression is almost always adverse to this variety, but its large yields and attractive grain are steadily extending its culture. In the irrigated sections of Montana and even South Dakota, the Chevalier is a favorite variety. A considerable quantity of this sort is grown in the Gallatin Valley of Montana. It is similar to the Hannchen, but it matures later and has a larger kernel. It is a favorite with the millers of pearled barley. Horn, a selection made by the United States Department of Agriculture, is similar to Chevalier. It has given higher yields and promises well on the dry lands of Wyoming and Montana as well as under irrigation. In Idaho, under irrigation almost any variety yields well. On account of the ease of culture, the 6-rowed types are the most common. Formerly Coast was widely grown, but it has been almost entirely replaced under irrigation by Trebi, a 6-rowed selection made by the United States Department of Agriculture which has produced very high yields. The Chevalier, White Smyrna, and Hannchen varieties are grown to a limited extent.

At high altitudes and in places of very low rainfall coupled with high temperature, hooded varieties are grown to some extent. At high altitudes the Nepal, a 6-rowed, hooded, naked, early variety is frequently grown. On the southern Plains and parts of Oregon and Washington small areas of Horsford are grown. This is similar to the Nepal, but hulled instead of naked. In parts of South Dakota, where hot dry weather comes on early and suddenly, early-maturing varieties are preferred. The Gatami has done well under such extreme conditions. It is a 6-rowed, awned, black-hulled variety.

In the Great Basin a winter variety known variously as Winter Club, White Club, or Utah Winter is occasionally grown. It is a dense, 6-rowed, awned, hulled variety.

In the humid-spring region there are no sharply defined local areas.

In Michigan a winter barley has been developed which is reported as promising by the Michigan Agricultural Experiment Station. The northeastern part of the region is well adapted to the production of the Hanna variety, but it has not yielded as well as the Manchuria in New York. Recently in New York, Alpha, a 2-rowed hybrid variety, has come into field culture and has given high yields. Featherston is the best variety of the Manchuria type.

In the humid-winter area the localities are classified on the presence or absence of barley rather than on the kinds of barley. The production is almost all in the mountain districts, although a small acreage is grown in the Piedmont area. The total production is small.

TABLE 5.—*Description and adaptation of the varieties of barley most frequently found in field culture*

Classification, variety, and synonyms [1]	Description					Region adapted	Area of special adaptation
	Kernel rows	Color [2]	Hulls	Awns	Spike		
Three principal type varieties:							
Coast	6	White	Hulled	Awned	Lax	Semiarid	
Manchuria and Oderbrucker (*Manshury*).	6	do	do	do	do	Humid spring.	
Tennessee Winter	6	do	do	do	do	Humid winter	
Important minor varieties of less extensive distribution:							
Chevalier	2	do	do	do	do	Semiarid, irrigated.	Northern irrigated lands.
Horn	2	do	do	do	do	Semiarid	Montana and Wyoming.
Hannchen	2	do	do	do	do	do	Northern Plains and the West.
Alpha	2	do	do	do	do	Humid	New York State.
Club Mariout	6	do	do	do	Dense	Semiarid	California and the Great Basin.
White Smyrna	2	do	do	do	Lax	do	Montana and Wyoming.
Trebi	6	do	do	do	do	Semiarid, irrigated.	Great Basin.
Winter Club (*White Club, Utah Winter*).	6	do	do	do	Dense	Semiarid	Great Basin, fall seeding.
Less important minor varieties:							
Beldi Giant	6	do	do	do	Lax	do	About as Coast.
Gatami	6	Black	do	do	do	do	Severe summer conditions, northern Plains.
Hanna	2	White	do	do	do	Semiarid, humid spring.	
Himalaya (*Guy Mayle*).	6	Blue	Naked	do	do	Semiarid	Northern Plains.
Horsford (*Success, Beardless*).	6	White	Hulled	Hooded	do	do	Southern Plains.
Nepal (*White Hull-less, Beardless*).	6	do	Naked	do	do	Semiarid, humid spring.	Rocky Mountains.

[1] Synonyms are indicated by italic type in parentheses.
[2] In the hulled varieties the color refers to the glume only. Some of the white-hulled sorts have blue aleurone layers.

WHAT VARIETY TO GROW

In general it is best to grow one of the three standard commercial types, depending upon the region in which the grower lives. These

types are the Coast, the Manchuria-Oderbrucker, and the Tennessee Winter. If the farm is located in a definite subdivision of one of these regions, varieties of such local adaptation should be used where seed is available. The most conspicuous cases of special adaptation are Alpha for New York State, Hannchen for the northern Great Plains, White Smyrna and Horn for the Montana dry lands, Chevalier for the Montana irrigated lands, Trebi for irrigated lands of the Great Basin, and Club Mariont in California. Spikes of four of these are shown in Figure 9. The State experiment stations should be consulted, as they are in a position to know the local variations which may determine the use of varieties. The character of the more important varieties may be seen in Table 5.

FIG. 9.—Spikes of five varieties of barley suited to areas in the arid region: *a*, Hannchen (Northern Plains and Great Basin); *b*, White Smyrna (Montana and bordering areas); *c*, Chevalier (irrigated and subirrigated lands); *d*, Club Mariout (late seeding in California and the Great Basin); *e*, Nepal (mountain districts and for hay)

WHERE TO PROCURE SEED

Seed should be obtained locally where possible. Seed of the three main types can be secured readily in any quantity through a large number of agencies. The Coast barley is handled by all grain dealers, elevators, and seedsmen of the West. The Manchuria and Oderbrucker are similarly handled in the northern Mississippi Valley. Many of the States have grain growers' associations which produce a better grade of seed, often of selected strains. These associations usually have a representative on the State experiment station staff from whom all information can be obtained. The Tennessee Winter barley is handled by southern seedsmen and by some grain dealers in the region of heaviest production.

The varieties of local adaptation are more difficult to secure. In most cases their culture is so recent that large lots of seed are not available. The Chevalier can be obtained in quantity in the Gallatin Valley of Montana, and considerable Hannchen has been distributed by the substations of South Dakota. There is a small production of White Smyrna in Montana, which so far has all been absorbed by local buyers of seed. Trebi is easily procured in southern Idaho, and there is a fair supply of Alpha in New York.

DISEASES

Barley is not commonly subject to heavy infections of diseases. Its freedom from rust accounts in part for the practice of seeding it on lands where the planting of spring wheat is delayed to the point of danger. Barley is not immune to rust, and very late seedings are sometimes damaged. There is generally a small percentage of loose smut in barley and a varying percentage of stripe diseases. The stripe diseases, according to recent studies, appear to be of greater importance than was formerly thought to be the case. They may eventually demand specific effort toward their prevention. At the present time only one barley disease is of clear-cut economic importance, for which recommendations of seed treatment are widely urged. This is the covered smut, which can be distinguished from the loose smut through the fact that the smut balls which displace the seed persist in the covered smut, but are broken up and dispersed by the wind before harvest in the loose smut. These smuts are shown in Figure 10. The importance of covered smut seems to vary inversely with the rainfall of the harvesting months. In the humid regions it is of only sporadic importance, the greater part of the fields escaping with unimportant losses. In the semiarid regions there is a gradual increase in infection, culminating in frequent heavy

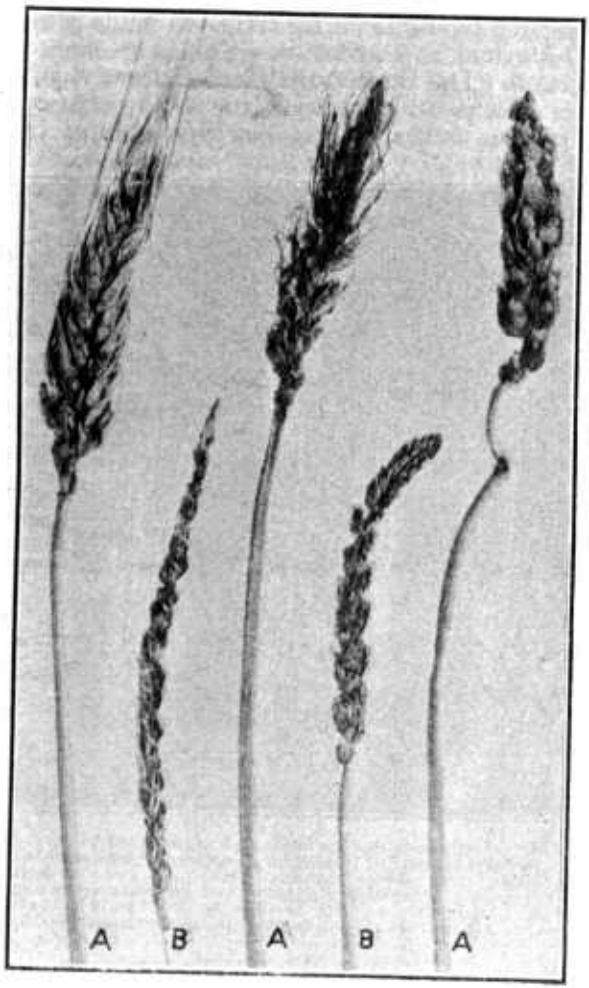

FIG. 10.—The covered and loose smuts of barley: *A*, Covered smut, in which the kernel is replaced by masses of spores, which are broken apart and mixed with the grain in threshing; *B*, loose smut, a form wherein the entire spikelet is replaced by a mass of spores, which upon maturity are scattered by the wind, leaving only the bare stems as evidence of the disease

losses in the Palouse district of Washington and Idaho and in parts of California.

Wherever the infection assumes any considerable importance, provision should be made for better conditions the following year. If clean seed can be obtained, it should be used. Clean seed is to be preferred to treated seed. If it can not be obtained, the seed should be treated with formaldehyde, 1 pound to 40 gallons of water.

The sprinkling method is not effective with the covered smut of barley. The method known as "soaking and skimming" is to be preferred. Place the solution in tubs or other containers and pour the grain in. Stir thoroughly. The stirring brings the smut balls to the surface, where they can be skimmed off. After skimming, remove the grain; pile and cover two to five hours with bags or canvas previously treated with formaldehyde. Make germination tests of treated seed to determine the extent of injury. Increase the quantity of seed per acre to cover injury and swelling. Although the danger of seed injury in barley is much less than in wheat, some farmers prefer to treat only a seed plat for the next year's stock. When this method is used, the seed plat should be treated annually.

When the clean or treated seed is finally available for seeding, care should be taken to avoid reinfection. The drill should be disinfected with the formaldehyde solution and used sacks avoided. If the crop of the following year is clean and suitable for seed, care should be taken that the threshing machine has not come directly from a field of smutty barley. If smutty barley was the last crop threshed, the machine should be disinfected as far as possible. The same precaution should be taken with respect to the bins and sacks. Keep the disease out by sanitary measures when possible; when not possible, treat the seed.

SUMMARY

The United States may be divided into three barley regions, which differ in economic, cultural, and varietal aspects—the semiarid, or western; the humid spring, or northeastern; and the humid winter, or southeastern.

In the semiarid region the Great Plains, the Great Basin, and the Pacific coast are well-defined subdivisions.

Barley is most profitable as a primary crop, but is a valuable secondary crop, as when it is used for late seeding in the spring-wheat region or to clean weedy fields.

The best barley lands are well-drained soils that are not sandy. Heavy loams are the best. Barley should not be seeded on poorly drained or light sandy lands.

Barley is a cool-weather plant. The best conditions of growth are found in early spring. In the humid regions, south of those sections where the summers are cool, early seeding is of vital importance.

Barnyard manures in the humid-spring region should be applied to the previous crop, as they induce lodging when applied to barley. The use of commercial fertilizers for barley is at present limited largely to the Eastern and Southern States.

Good seed of a good variety, well matured, well cleaned, and free from weed seeds and diseases, is an insurance that the crop starts

without a handicap. A good seed bed will promote the initial growth.

Fall plowing in the humid-spring region, disked corn ground in the Great Plains, and summer fallow in regions west of the Rocky Mountains are the best methods of preparation.

Early seeding is necessary to obtain maximum returns. On the northern Plains the loss from seeding delayed beyond April 25 is more than 1 per cent a day.

In the humid sections 2 bushels are usually seeded. The rate decreases with the decrease in rainfall. In the driest sections 3 or 4 pecks is sufficient.

The depth of seeding varies from 1½ inches in the humid regions to 2½ or 3 inches in the Great Basin.

The best method of seeding is with the grain drill.

Barley should be mature when harvested, but should not be allowed to stand until the losses from shattering become important. The varieties of the humid region shatter more than those of the semi-arid regions.

The best method of harvesting is with the grain binder. The combined harvester is cheaper to operate, but the losses are greater.

Grain must be shocked and stacked, so as to suffer the least weather damage possible. Care should be taken in threshing that few kernels are broken. Close threshing decreases the market price of malting barley.

Barley is manufactured into malt, pearled barley, breakfast food, and flour. The malting trade demands a grain that is clean, plump; free from weather, bin, or threshing damage; and of high viability.

On account of its high acre yield barley should be more widely grown for stock feed. Through the Northern and Western States it should replace oats to a considerable extent. It may be fed whole, but is better rolled or coarse ground.

In present practice each of the three regions has a predominant type that succeeds well throughout that region. These are the Coast in the arid region, the Manchuria and Oderbrucker in the humid-spring region, and the Tennessee Winter in the humid-winter region. Of the less widely grown varieties, the Hannchen does well almost anywhere, but seems particularly adapted to the middle Plains. In Montana White Smyrna and Horn are superior. In the Great Basin, in addition to the Coast, the Club Mariout and Hannchen are promising. In California Coast and Club Mariout are the leading varieties. Under irrigation the Trebi in the Great Basin and the Chevalier in Montana are especially well adapted.

The covered smut is an important source of losses in the dry regions, especially in eastern Washington and Oregon.

Disease-free seed should be obtained, if possible. If this is not possible the seed should be treated.

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October 1, 1925

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